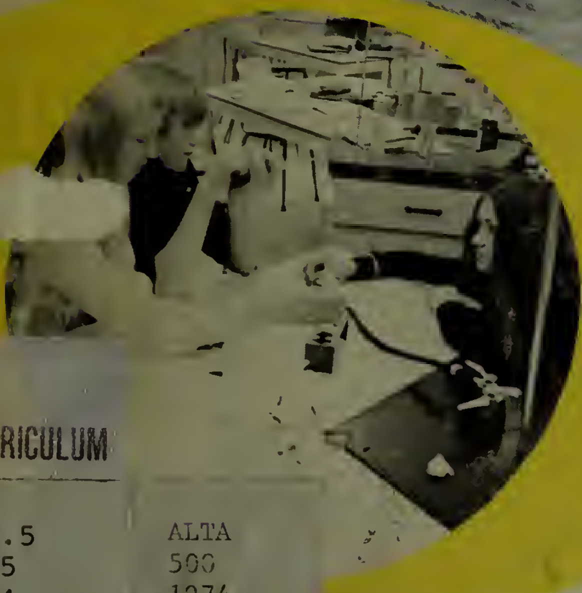
CURRICULUM GUIDE



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JUNIOR HIGH SCHOOL SCIENCE

Alberta
EDUCATION

ACKNOWLEDGEMENTS

The Department of Education acknowledges with appreciation the contributions of the following members of the Junior High School Science Ad Hoc Committee who have worked in the preparation of this curriculum guide. This ad hoc committee has worked under the guidance of the Secondary School Science Policy Committee.

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NOTE: This curriculum guide is *a service publication only*. The Junior High School Program of Studies contains the official statement concerning the Junior High Science. The information contained in this guide is prescriptive insofar as it duplicates that which is in the Program of Studies.

OBJECTIVES OF SECONDARY SCHOOL SCIENCE FOR ALBERTA

The learning of science as an area of human endeavor, should provide the student with a scientific literacy which enables him to assume an active and useful role as a citizen in a democratic society. It may be assumed that this literacy is best achieved by considering the individual needs of students and through independent study and learning.

The objectives of Secondary School Science are:

1. To promote an understanding of the role that science has had in the development of societies:

    a. history and philosophy of science as part of human history and philosophy

    b. interaction of science and technology

    c. effect of science on health, population growth and distribution, development of resources, communication and transportation, etc.

2. To promote an awareness of the humanistic implications of science:

    a. moral and ethical problems in the use and misuse of science

    b. science for leisure-time activities.

3. To develop a critical understanding of those current social problems which have a significant scientific component in terms of their cause and/or their solution:

    a. depletion of natural resources

    b. pollution of water and air

    c. overpopulation

    d. improper use of chemicals

    e. science for the consumer

4. To promote understanding of and development of skill in the methods used by scientists:

    a. processes in scientific inquiry such as observing, hypothesizing, classifying, experimenting and interpreting data

    b. intellectual abilities such as intuition, rational thinking, creativity, and critical thinking

   c. skills such as manipulation of materials, communication, solving problems in groups, and leadership.

5. To promote assimilation of scientific knowledge:

   a. emphasis on fundamental ideas

   b. relevance of scientific knowledge through inclusion of practical applications

   c. application of mathematics in science

   d. interrelationships between the sciences

   e. open-endedness of science and the tentativeness of scientific knowledge.

6. To develop attitudes, interests, values, appreciations, and adjustments similar to those exhibited by scientists at work.

7. To contribute to the development of vocational knowledge and skill:

   a. science as a vocation

   b. science as background to technical, professional and other vocations.

PHILOSOPHY AND GOALS OF THE JUNIOR HIGH SCIENCE PROGRAM

A. The paramount goal is the student's understanding of the natural world. While understanding cannot be developed in the absence of supporting facts, the memorization of unwarranted detail is to be avoided. However, mastery of a limited number of technical terms is essential for precise communication. The objective is to help in the development of an individual who is aware, informed and concerned about the natural world.

B. The courses are designed to make the student familiar with his natural environment and interrelationships that exist in this environment. Every student should be given the opportunity to pursue investigative activities, and adequate facilities and opportunities should be provided for these activities.

C. Although recommended texts are listed for each course, it is suggested that teachers also make use of the secondary reference list to develop units of study. It is recommended that teachers exercise professional judgment in ordering references for the school library.

D. The Junior High Science program continues to emphasize skills, concepts, attitudes, and humanistic and social implications of science which have been developed in the elementary program.

Content is therefore significant only to the degree that it provides for the realization of other objectives of the program. Student interest should be a significant criterion in the selection of learning experiences.

E. The Junior High Science program further develops, in the context of Life, Earth, and Physical science, the six conceptual schemes outlined for the Elementary Science program:

I. When energy changes from one form to another, the total amount of energy remains *constant*.

II. When matter changes from one form to another, the total amount remains *constant*.

III. Living things are interdependent with one another and with their environment.

IV. A living thing is the product of its heredity and environment.

V. Living things are in constant change.

VI. The universe, and its component bodies, are constantly changing.

The Junior High Science program attempts to provide a background of basic science knowledge for students who may pursue a wide variety of programs, both formal and informal, once they leave grade nine. It is not the intent that students be prepared for any one program but rather that they be encouraged to explore as widely as possible in response to their interests within the general outline of the program.

MAJOR OBJECTIVES OF JUNIOR HIGH SCIENCE

1. To develop student awareness of the humanistic and social implications of science. The student should study issues such as these:

    a. evaluation of commercial messages

    b. depletion of non-renewable resources

    c. use and misuse of scientific discoveries.

2. To develop the student's ability to understand and appreciate the nature of science and his role as an investigator and learner. The student should develop:

    a. science process skills

    b. communication skills

    c. interpretative and computational skills based on collected data.

3. To develop student attitudes, interests, values, appreciations and adjustments similar to those exhibited by scientists at work. This may be achieved by involving the student in:

    a. an active program of field experiences

    b. a program of bringing items to the classroom

    c. the use of resource people in the classroom.

4. To have the student develop basic concepts in Life, Earth and Physical science. In the development of these concepts the student should have practice in:

    a. interpreting and evaluating fundamental ideas

    b. relating scientific knowledge to practical everyday life

    c. dealing with concepts which illustrate the sometimes tentative nature of science knowledge.

5. To have the student develop basic skills of, and attitudes toward safe practices.

SKILLS TO BE DEVELOPED IN SCIENCE

1. PROCESS SKILLS

A key objective of the Junior High Science program is to make the student an increasingly active and dynamic investigator of science--using the processes of the scientist. Through conscious, systematic development of these processes, the student becomes increasingly better equipped for more complex learning in the fields of science as well as in other areas of investigation.

The following processes are considered to be an essential part of the student's learning:

(a) Observing--using all the senses
(b) Classifying--grouping related objects or ideas
(c) Quantifying--using numbers and measurements
(d) Communicating--using such means as discussion, tabulation, graphing...
(e) Inferring
(f) Predicting
(g) Formulating hypotheses
(h) Defining terms
(i) Controlling variables
(j) Interpreting data and results
(k) Formulating models--verbal, pictorial, and concrete
(l) Experimenting--planning and designing an investigation
(m) Processing of data--organizing, representing graphically, treating mathematically
(n) Identifying problems
(o) Seeking further evidence
(p) Applying discovered knowledge

Some of these processes may be developed in the following manner.*

Process	Description of Behavior	Example Activities
OBSERVING	The desired pupil behavior is increasing competence in using not only his sense of sight but also his other senses of hearing, touch, smell and taste.	*These may involve both oral and written descriptions of the following: Identify and name colours, textures, relative sizes and other properties of objects. Distinguish differences in temperature,*

*AAAS, *Commentary for Teachers*. American Association for the Advancement of Science.

Process	Description of Behavior	Example Activities
		read temperature on a thermometer, identify and name factors in weather such as temperature and precipitation; identify possible causes of change, such as heat, wind and air pressure, show the effect or cause of change on an object such as a balloon; describe selected items so that others can identify and name the main parts of a plant; describe plant growth over a period of time; describe the relationship between two variables.
CLASSIFYING	The desired pupil behavior is increasing competence in grouping articles, objects and ideas on the basis of some observable property or properties.	*Objects may be classified according to smoothness, texture, color, and special characteristics. Single-stage classifications are followed by two-stage and multi-stage classifications.*
QUANTIFYING	The desired pupil behavior is increasing competence in measuring length, weight, area, volume, and rate of change of the physical world.	*The following are illustrative: Distinguish objects by using such terms as heavier and lighter; identify relative weight by lifting; use a balance to distinguish heavier from lighter objects; use standard units of weight; explain effects of gravitation and inertia; measure the weight of various objects; describe differences in weight; identify, state and demonstrate differences in perception of weight.*
FORMULATING HYPOTHESES	The desired pupil behavior involves developing increasing competence in stating an hypothesis regarding causes of a phenomenon or the relationship between two variables. An hypothesis tells how to observe an expected outcome of an experiment.	*The following illustrate hypotheses:* *1. If the air pressure inside a tube is less than the air pressure outside a tube, then water will rise in the tube.* *2. If a ball is dropped, its speed will increase as it approaches the floor.*

Process	Description of Behavior	Example Activities
MAKING OPERATIONAL DEFINITIONS	The pupil should demonstrate increasing competence in stating the minimum things to do or look for in order to identify the subject being defined.	*The following are illustrative: Cold means 15°C for this experiment; little friction means that not more than an additional 10% of force over and above the weight of the object is required to move the object across a surface.*
CONTROLLING AND MANIPULATING VARIABLES	The desired pupil behavior is increasing competence in arranging conditions to be able to deliberately control and manipulate objects or conditions in an experiment.	*The following examples are illustrative:* *1. Consider two pendula swinging at different rates. Variables to control might include: the weights (size, shape, and mass), the string (length and thickness), and the length of swing.* *2. Metals expand when heated. Variables to control might include: kind of metal and the temperature.*
INTERPRETING DATA	The desired pupil behavior is increasing competence in getting the most out of data without oversimplifying, drawing conclusions supported by the data, and considering alternative explanations.	*Interpretations may be made of observations made in the form of verbal statements, graphs, histograms and tables.*
FORMULATING MODELS	The desired pupil behavior is increasing competence in building both physical and mental models to account for phenomena.	*The following models are illustrative:* *1. Pictures of the moon's surface* *2. Diagrams of the life cycle of an insect* *3. Physical model of a chromosome* *4. Mental model--idea of an atom.*
COMMUNICATING	The desired pupil behavior is increasing competence in describing an experiment so that an individual who has not	*Experiences in identifying and naming objects are followed by graphing and describing measured changes as shown in the following examples:*

Process	Description of Behavior	Example Activities
	seen it can carry it out.	*Identify and name events that can be quantified, such as five bounces of a ball; make a column in a bar graph to represent the frequency of an event; distinguish events shown in a graph; make a bar graph; describe measured changes in speed, temperature, and other properties, make a prediction on the basis of recorded measures; make a graph to show the prediction; describe an experiment so that others might do it.*
INFERRING	The desired pupil behavior is increasing competence in drawing more than one inference from a set of data, demonstrating that inference can be tested by further observation, and demonstrating that an inference can be tested by applying known tests to the properties of objects. Pupils should indicate that they are able to distinguish between observations and inferences.	*The following sequence is illustrative. Use the concept "evaporation" to explain how water is lost by plants; demonstrate a way to measure the water used by a plant; infer and demonstrate that water drawn through plants is transferred to the atmosphere; show that an inference may be tested by additional observations.*
PREDICTING	The desired pupil behavior is increasing competence in conducting experiments to test predictions of relationships between two measurable quantities.	*Various tasks might include: plotting data, making and interpreting graphs, and observing from different vantage points. For example, analyze a graph to determine the pattern relationships (increasing, decreasing, stable); use a graph to predict water loss from plants; make predictions from a series of observations by means of graphs; conduct an experiment to test predictions.*

Process	Description of Behavior	Example Activities
EXPERIMENTING	The desired pupil behavior is increasing competence in planning, conducting and communicating experiments in which the problem is clarified, hypotheses are stated, observations are made, and data interpreted. This process depends upon the pupil being able to use all of the other processes.	*Pupils might develop experiments to answer the following questions:* *1. How do mealworms react to light?* *2. How many nails can a magnet lift?* *3. What happens to salt when it is placed in water? Does more salt dissolve in water at 35°C than at 20°C?*

2. MOTOR SKILLS

In order to develop manipulative skills, students in Junior High Science must have frequent opportunities for first-hand investigative experiences that involve the handling of materials and equipment.

ATTITUDES TO BE DEVELOPED

Much of the spirit and meaning of science is transmitted to students from the teacher. Some of the attitudes the teacher should endeavor to develop in students are:

1. Curiosity and interest
2. Intellectual honesty
3. Open-mindedness
4. Belief in cause-effect relationships
5. Suspended judgment when data inadequate
6. A respect for accuracy and precision
7. Skepticism of statements which may be biased or based on inadequate information.

LIFE SCIENCE

SPECIFIC OBJECTIVES OF GRADE 7 SCIENCE

LIFE SCIENCE

Teaching Dimension

1. An awareness of the social implications of science can be achieved by having students participate in activities such as:

   a. discussion groups, interview sessions, community visits

   b. experiences in becoming actively involved in intellectual and emotional issues by participating in debates and active community study programs.

2. An appreciation of the nature of science may be achieved by having the student:

   a. participate in an activity-centered laboratory program

   b. study representative samples from the environment taking care not to deplete or destroy the study area

   c. keep records and report to a group in an organized fashion.

3. The development of positive attitudes and interests can be nurtured by:

   a. assigning students to assist in the care of plants and animals used in the program

   b. assigning students to assist with laboratory responsibilities and participate in demonstrations.

4. The acquisition of the basic concepts by students can be fostered by

    a. participation in a multitude of different kinds of activities ranging from small group and independent projects to large group viewing of films and demonstrations

    b. exposure to and use of as wide a variety of media presentations as is possible.

5. The development of safe practices should include such activities as:

    a. the wearing of gloves and protective clothing when handling animals

    b. the identification of toxic plants and care in handling plant material

    c. the recognition of potential hazards when working with insect forms and cultures of micro-organisms.

CONCEPTS TO BE DEVELOPED

Teachers are to use discretion regarding the number of subconcepts undertaken and the depth of coverage in each case.

CONCEPTUAL DIMENSION

A. All sets of objects including living things may be classified into groups having common characteristics.

Subconcepts

1. Classification makes thinking about a large number of things simpler and easier.
   a. Within large groups, members share some common characteristics; within smaller subgroups, members share a greater number of common characteristics.

2. An international system of classifying living things has been developed to facilitate the organization and exchange of knowledge of living things.
   a. Living things may be classified as protist, plant or animal.

3. A simple key may be used to facilitate identification of organisms.

B. Cells are the unit of structure and function of most living things.

1. The techniques and tools of scientists aid in observing things (e.g. microscopes, balances, etc.)

2. Plant and animal cells share many common characteristics.

3. Cells live independently or in groups.
   a. Single celled organisms perform all the functions necessary for life.
   b. Some cells in multi-cellular organisms are specialized to carry out specific functions.

C. Living things carry on certain fundamental processes in order to sustain life.

1. Organisms require nutrients for energy.
   a. Green plants are the primary producers of food (photosynthesis).
   b. Digestion is the process of breaking down food.
   c. There is a chain of food and energy from primary producers to consumers to decomposers.

2. All living things obtain their energy from *respiration.*
   a. Respiration is the oxidation of sugar in controlled conditions.
   b. Organisms obtain oxygen from their environment in a variety of ways.

3. Food products and gases must be circulated to all cells throughout an organism (circulation).
   a. Cells receive nourishment and eliminate waste through the process of diffusion.
   b. More complex organisms show need for a more specialized circulatory system.

4. Organisms eliminate wastes to their environment (egestion and excretion).

5. *Growth* of an organism may result in change in structure or proportion, or an increase in size.

6. Living things react to their internal and external environment (sensitivity).
   a. Different species may have different ways of receiving and responding to stimuli.
   b. Living things differ in their response to the environment (adaptation).

7. To ensure survival of the species, living organisms must *reproduce.*
   a. Some organisms reproduce sexually, some asexually, and some by both means.
   b. An offspring inherits certain characteristics from its parents.
   c. There are many variations within a population.
   d. Living things have developed a variety of structural and behavioral adaptations to ensure reproduction.

D. All living things interact with and are interdependent with each other and their environment.

1. The biosphere is the region in which life on our planet is possible.

2. Eco-systems are units in the biosphere in which living and non-living things interact.

3. Plants and animals living and interacting in any eco-system are known as a community.

4. The members of each community show adaptations which are necessary for survival in the community.
   a. Some organisms are specific to certain communities (distribution).
   b. Some organisms may exist in more than one community (tolerance).

5. An organism is the product of both heredity and environment.

6. The environment and the distribution of organisms are in a state of continual change.
   a. Nature constantly re-cycles materials.
   b. Changes may take place over an extended period of time.

7. Man's influence on the environment can be directed constructively.
   a. Man's influence may increase the rate of change with beneficial or harmful results to the environment.
   b. Man commands the use of a great supply of energy to change the environment to his liking.
   c. Man's production and use of energy causes pollution.
   d. The preservation of man's biological resources depends on an awareness and the positive action of each individual.

PRINT RESOURCES - GRADE 7 - LIFE SCIENCE

RECOMMENDED TEXTBOOKS

*Nuffield Foundation, Text 1, *Introducing Living Things*, Longman Canada 1966.
Text 2, *Life and Living Processes*, Longman Canada 1966.

*Thurber & Kilburn, *Exploring Life Science*, MacMillan of Canada, 1968.

SECONDARY REFERENCES

TITLE	AUTHOR	PUBLISHER
The Earth: It's Living Things	Brandwein, Beck, Strohler, Brennan & Turner	Longman, 1970
Life: It's Forms and Changes - 2nd Ed.	Brandwein, Stollberg, Greenstone, Yasso & Brovey	Longman, 1972
Life Science: A Problem Solving Approach	Carter, Goodman, Hunter & Schelske	Ginn 1971
Biology by Inquiry - Book 1	Clarke, Booth, Grigsby, Haddow, & Irvine	Bellhaven, 1968
Examining Your Environment - Series of 8 paperbacks *Birds, Miniclimates, Pollution, Running Water, Snow & Ice, Trees, Mapping Small Places and Astronomy*	Couchman, MacBean, Stecher & Wentworth	Holt, Rinehart & Winston 1971
Life Science Investigations: Man and the Environment - coupled with 4 stimulation games	E.R.C.	Nelson 1971
Modern Life Science	Fitzpatrick & Hole	Holt, Rinehart & Winston 1970

*Under Review.

TITLE	AUTHOR	PUBLISHER
The Biological Sciences	Frazier & Smith	Laidlaw (Doubleday) 1971
Alberta: A Natural History	Hardy	Hurtig
Focus on Life Science	Heimler & Lockard	Merrill, 1969
Interaction of Man & the Biosphere	I.S.C.P.	Gage 1970
Life Science: A Laboratory Approach	Marean, Johnson & Menhusen	Addison-Wesley, 1972
Nuffield Biology	Melnychuk, Jacknicke & Visscher	Longman 1970
Life in the Environment, The Biological Sciences	Navarra, Zafforoni & Garone	Harper & Row (Fitzhenry & Whiteside) 1973
Pathways in Science: Biology 1, 2 and 3	Oxenhorn	Book Society of Canada, 1968
Challenges to Science: Life Science	Smallwood	McGraw-Hill 1973
Ryerson Science in Action Series	Woolley et al	McGraw-Hill Ryerson, 1969-73
The Outdoors: Studies for open places	MacKillian, Wilson & Woolley	
The Outdoors: Studies for Woodlands	Bates	
-Studying Birds	Wilson	
-Studying Soil	MacKillian	
-Studying Insects	Sadler	
-Studying Streams	Daynes	
-Studying Plants	Sadler	
-Studying Mammals	Dawson & Currie	
Teaching Outdoors	Vanden Hazel & Benson	

TITLE	AUTHOR	PUBLISHER
Life Science	Wong, Bernstein & Shevick	Prentice-Hall 1973

Teacher Reference Books

Toward More Effective Science Instruction in Secondary Education. H. O. Anderson & P. G. Koutnik, Collier-Macmillan 1972.

Teaching High School Science: A Sourcebook for the Biological Science. E. Norholt, P. F. Brandwein and A. Joseph; Longman Canada, 1958.

Sourcebook for Biological Sciences. D. L. Troyer, M. G. Kellogg, H. O. Andersen; Collier-Macmillan, 1972.

Inquiry Techniques for Teaching Science. W. D. Romey; Prentice-Hall, 1968.

Teaching Science with Garbage. Schatz & Schatz; Rodale Press (Copp Clark Publishing)

General Reference Books

Golden Nature Guides, Zim et al; Golden Press (Fitzhenry & Whiteside)

-Birds
-Butterflies and Moths
-Fishes
-Flowers
-Gamebirds
-Insect Pests
-Insects
-Mammals
-Non-flowering Plants
-Pond Life
-Reptiles and Amphibians
-Seashells of the World
-Seashores
-Spiders
-Trees
-Zoology-Ecology

Biology Field Guides, School Book Branch, Department of Education, Edmonton.

EARTH SCIENCE

SPECIFIC OBJECTIVES OF GRADE 8 SCIENCE

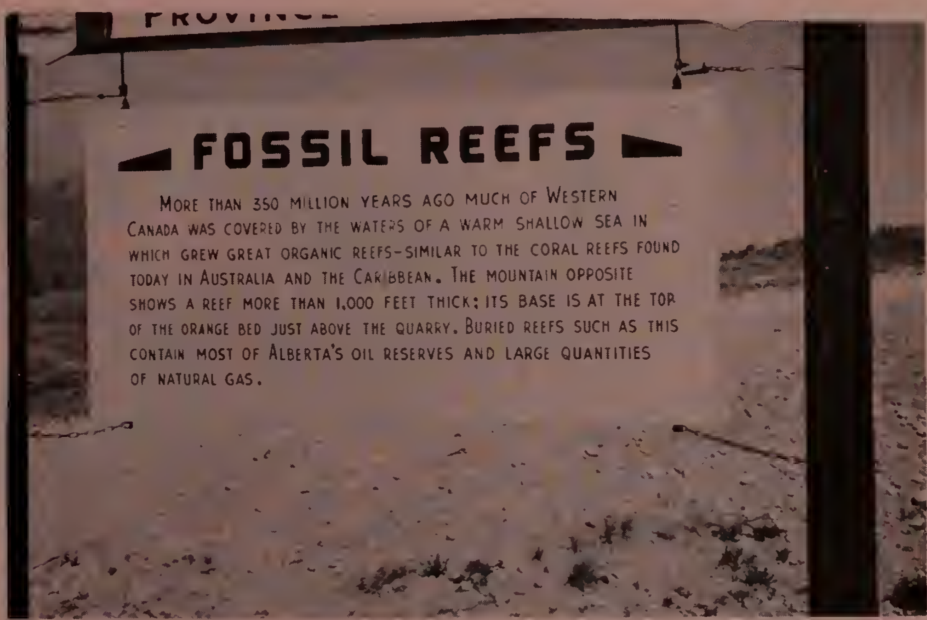
EARTH SCIENCE

TEACHING DIMENSION

1. An awareness of the social implications of science can be achieved by having students:

   a. participate in a study of the resource development of the fossil fuel industries in Alberta, the asbestos mining in Quebec and/or iron mining in Ontario

   b. investigate the products of the space programs and their effect on our standard of living. Such investigations might include integrated circuits, medical technology, clothing, guidance systems, pyro-ceram, metal alloys, satellite communications and Earth Resources Technology Satellite photographs.



   c. participate in a regular and systematic examination of the current literature--newspapers, periodicals and miscellaneous newsletters.

2. An appreciation of the nature of science may be stimulated by having the student:

    a. participate in a hands-on, activity-centered approach when in the classroom

    b. participate in regular out-of-class visits to various community resources related to the concepts being learned

    c. collect a series of weather maps and relate these to actual conditions.

3. The development of positive attitudes towards and interests in science may be fostered by having students:

    a. contribute materials from the neighborhood towards the construction of models and dioramas

    b. develop responsibility for the various aspects of the laboratory program

    c. carry out specific projects related to concepts being studied.

4. The acquisition of basic concepts can be fostered by a multi-media, activity-centered program that involves the student directly in his learning.

5. The development of safe practices should include the wearing of goggles and gloves when working with rocks.

CONCEPTS TO BE DEVELOPED

Teachers are to use discretion regarding the number of subconcepts undertaken and the depth of coverage in each case.

CONCEPTUAL DIMENSIONS

	Subconcepts
A. A perspective of the position and motion of the Earth in space is gained by celestial observation and measurements.	1. Through history man has searched for a systematic way of orienting himself and explaining his observations. 2. The motions of the Earth with respect to its neighbors have a profound effect on man. 3. The tools and technology used by Earth-Space scientists vary tremendously. a. Earth-Space scientists use information from their observations to develop explanations of the universe.
B. Various theories attempt to explain the origin of the solar system and the universe.	1. Man's religions offer an explanation of the Earth's origins. 2. Science views the origins in terms of observable processes. a. Big Bang Theory is widely held as a possible explanation. b. Many others hold that the Steady-State Theory is more acceptable. c. Solar system origins can be explained in other ways.
C. Matter everywhere in the universe seems to be composed of the same elements that are found on the Earth.	1. Our knowledge of the universe comes from an analysis of its radiation. a. Spectroscopic studies of the radiation aid in giving knowledge about stars and planets. b. Radiation is studied with optical and radio telescopes. 2. Matter is clustered more densely in some parts of the universe. a. The largest local clusters of matter are galaxies. -galaxies are accumulations of many stellar bodies.

b. Stars and other celestial bodies can be classified and grouped.

3. Matter in the universe appears to be moving at tremendous velocities.
   a. Interstellar distances are measured in light years, and astronomical units.
   b. Observations of celestial positions are made over a period of many years to determine motions in the universe.

D. The Sun is a typical star.

1. Much of what we surmise about stars comes from our observations of the Sun.
   a. Radiation from the Sun can be used to investigate its structure, motions, history and processes.
   b. Solar radiation is both beneficial and harmful to life on its planets.
   c. Solar gravity and planetary inertia maintain a system of planets in orbit.
      -Planetary motion is predictable.
      -The members of this solar system differ in their physical characteristics and dynamic properties:
        - several planets have satellites of their own,
        - the Moon provides an opportunity to study an extra-terrestrial body;
      -Exploration of space has generated new knowledge, new technologies, and new problems.

2. Most of the Earth's energy comes from the Sun.
   a. The radiation affects the atmosphere, the oceans and the land masses.

E. The surface of the Earth and its inhabitants are surrounded by an atmosphere of air.

1. Air is matter
   a. Air is a mixture of gases
   b. Air has weight and exerts pressure which can be measured.

2. The atmosphere is heated by the sun's energy which is absorbed by the Earth.
   a. Radiant energy from the Sun is transformed into sensible and latent heat. Much of the incoming heat is absorbed by the Earth and its oceans.

b. Heat absorption by the Earth varies.
   -Light colored areas reflect more heat than dark areas
   -Oceanic areas reflect more heat than continental areas;
   -The altitude of the Sun above the horizon affects the heat absorbed.

c. Absorbed heat is distributed by a number of mechanisms.
   -Radiation is a means by which a warm body loses heat
   -Convection currents distribute heat quickly and efficiently
   -The distribution of heat is also achieved by conduction.

3. The air of the atmosphere is in constant motion due to unequal heating and the rotation of the Earth.
   a. There is a pattern to the planetary winds with several clearly definable zones
   b. Local winds are affected by land forms and bodies of water.

4. Water vapor is an important constituent of air.
   a. Water vapor enters the atmosphere by evaporation
   b. Water vapor eventually condenses as the air is cooled and becomes saturated
      -Clouds and fog are condensed moisture suspended in the air
      -Precipitation is the result of moisture droplets becoming too large to remain in suspension.

F. Local conditions in the atmosphere are referred to as weather.

1. Weather reports give information about local and global atmospheric conditions.
   a. The information is gathered by instruments at weather stations and by weather satellites
   b. The information given includes reports of air pressure, air temperature, relative humidity, wind direction and speed, cloud cover and precipitation.
   c. The weather map is a record of the information gathered and is used to predict future weather.

		2.	An air mass is a large body of air with similar temperature and humidity at all levels. a. Fronts form at the boundary between different air masses. -Fronts can be classified -Changes in weather are often associated with fronts -Violent storms are often associated with fronts b. High pressure areas often serve to define the extent of air masses. c. Low pressure areas usually form in association with fronts.
G.	Weather conditions as recorded over a long period of time define the climate of a region.	1.	Weather statistics over a period of time can be used to compare one region with another. a. Latitude, altitude, and position with respect to certain land forms and bodies of water determine the climate in a region.
		2.	Climate determines much of man's activities, housing, dress and diet.
H.	Weather modification has occurred through man's activities.	1.	Atmospheric pollution has become a major issue.
		2.	Rain-making and hail suppression are active research topics
		3.	Fog and frost control has economic value.
I.	Water is an important part of the Earth's surface.	1.	The water cycle is the continuous movement of moisture from ocean to land and return.
	(Optional unit in terms of both depth and extent of coverage)	2.	The oceans form a large portion of the Earth's surface. a. Sea water contains many minerals in solution. b. There is a wide diversity of living organisms in the oceans. -The ocean's food supply may be very important to man's survival. c. The ocean floor has topography similar to that on the continents, with several important differences.

-The continental margins are very important features both politically and economically.

d. The circulation patterns of the ocean's water are the result of forces similar to those affecting the atmosphere.
   -Currents in ocean water are initiated by differences in density, salinity, and by the prevailing winds.
   -Movement of sea water tends to distribute heat.

e. Wave action within bodies of water is an important force in the modification of the shore line.

f. Tides are caused by the gravitational attraction between the Earth, Moon and Sun.

J. The crust of the Earth is constantly being changed.

1. Erosion is the process of wearing down of the land forms.

a. Precipitation falls on the land areas and runs off to the sea.
   -Running water on the land surface tends to reduce the relief;
   -The rate of erosion depends upon the amount of run off, the gradient of the slope, the type of rock, and the ground cover;
   -Water run-off forms brooks, which form streams, which form river systems;
   -Sediments may be redeposited many times on their journey to the sea;
   -Soil is formed from the breakdown of the rock material;
   -Water that does not run off is held as ground water near the surface. In cold regions the ground water is held in perma-frost;
   -In cold climates precipitation builds up into glaciers; glaciers move under the influence of gravity and in doing so change the land surface. Surface features serve as evidence of past glaciation.

b. Air movements carry materials from one place to another.
   -Windblown material is deposited in characteristic surface features.

-Soil removal by winds may have serious economic effects.

2. Landforms are being built up by movements within the crust.
   a. Forces within the Earth cause deformation of surface features.
      -Earthquakes are the result of movements of masses of rock.
      -Volcanism is associated with faulting in the crust.
      -Faulting and folding are the result of large forces in the crust.
   b. Forces acting on the crust result from the nature of the structure of the Earth.
   c. Theories have been advanced to explain how forces have acted on the crust to produce the present landforms.
      -Continental drift, plate tectonics and sea floor spreading are theories advanced to explain crustal deformation.

K. The crust of the Earth is formed of rocks.

1. Rocks can be categorized into three main groups.
   a. Initially all rocks were formed by the cooling magma of the Earth.
      -Texture and mineral content of igneous rocks can be used for identification.
   b. Erosion and/or deposition form sedimentary rocks.
      -Grain size and/or mineral content of sedimentary rocks can be used for identification.
   c. Metamorphic rocks are reconstituted sedimentary and igneous rocks.
      - Metamorphic rocks are classified on the basis of their mineral content and structure.

2. Materials from the crust have had an important influence on the history of man.
   a. Man has mined the Earth for materials since prehistoric times. The mining of certain minerals is economically very important in Canada.
   b. Fossil fuels and their products are important in the economy of Alberta.

c. Other rocks and minerals are of economic importance to Albertans.
d. Crustal materials are limited and exploitation must be managed for maximum benefit.

L. Evidence for determining the past history of the Earth comes from a study of the crust.

1. Age determinations can be estimated on the basis of rates of changes of crustal materials.
   a. Sediments have been laid down throughout the life of the Earth.
   b. Radioactive elements decay at a measurable rate.

2. Fossil evidence can be used to relate past events in the history of the Earth from one place to another.
   a. There are different kinds of fossil evidence; remains, casts, molds, and replacement fossils.
   b. Fossil evidence is used in oil and gas exploration.

3. Earth history can be divided into periods of time on the basis of the type of fossil evidence.
   a. Through geologic time life has become more complex and diversified.

PRINT RESOURCES - GRADE 8 - EARTH SCIENCE

RECOMMENDED TEXT

*Thurber & Kilburn, *Exploring Earth Science.* MacMillan of Canada, 1969.

SECONDARY REFERENCES

1. *Investigating the Earth* - American Geological Institute - Thomas Nelson and Son, 1973.

   Presents Earth Science in a unified manner utilizing a concept development approach. Many and unique investigations together with excellent illustrations all emphasize the inquiry orientation of the book. Written for the able or above-average student. Good as a teacher reference and as an alternate student reference.

2. *Focus on Earth Science* - 2nd Edition - Bishop, Lewis and Bronaugh - Charles E. Merrill Publishing, 1972.

   Fairly detailed coverage of the Earth, its rocks and minerals, its crust, and its atmosphere. Well illustrated with end-of-chapter activities serving as good review. Activities or laboratory work are supplemental rather than essential to the content presented. Reading level likely above that of the average Grade VIII student. Useful as a teacher and/or student general reference.

3. *The Earth: Its Changing Form* - Brandwein, Beck, Strohler, Brennan and Turner - Longman Canada Ltd., 1970.

   Material covered organized around concepts. Only partially covers topics contained in Alberta Earth Science program. Physical Science background, as it relates to Earth Science, given prominence. Diagrams and photographs good and related to content. Could be useful as a supplementary reference or library reference.

4. *Earth Science* - by Brown, Kemper and Lewis, - G.L.C. Educational Materials and Services, 1970.

   This text emphasizes the historical development of accepted Earth Science concepts. It is well illustrated with colored photographs and line diagrams emphasizing the geology of the United States. The book is a useful source of information for the better reader and more able student. The booklet of investigations is entirely separate from the text and not directly correlated with it.

*Under review.

5. *Challenges to Science: Earth Science* - Heller, Byrne, et al, McGraw-Hill, 1973.

A content-oriented text written in a colloquial style which will appeal to many students. Most topics normally studied in Grade VIII are presented at a level involving a good deal of physics and chemistry. Student activities, though rather limited, do relate directly to content. The selection of color photos and diagrams appears adequate, but may have to be supplemented for some purposes. The book is probably most useful as a student and teacher reference.

6. *The Earth-Space Sciences* - Hibbs-Eiss, Doubleday, 1971.

A Solid and comprehensive book that presents a broad, integrated perspective of the universe, the solar system, and the Earth. The controlled vocabulary used in the text all but ensures that the student learns the necessary terms as they first appear in their proper context. The process dimension is introduced in practically every lesson. The style is readable and clear, and much thought must have gone into the selection of the diagrams and photographs which amply illustrate the text. The book can be recommended for use as a well-balanced text-activity program that introduces students to Earth-Space science, and shows them the way in the search for answers.

7. *Interaction of Earth and Time* - I.S.C.P. - Gage & Company, 1972.

This text uses activities, investigations and experiments to focus on Earth Science concepts and on science processes. Kits of laboratory supplies are recommended but most of the experiments can be performed with inexpensive materials. Many fine colored photographs and historical prints are included.

8. *Probing the Natural World* - I.S.C.S., General Learning Corp., 1972.

   (a) *Crusty Problems* - Continental Drift; Rocks and Minerals; Glaciation; Erosion; Waves and Shorelands
   (b) *Winds and Weather*
   (c) *What's Up* - Rocketry and space probes; the Moon
   (d) *In Orbit* - Radiant energy; the Sun

This program contains four modules useful for specific sections of the Grade 8 course. It has many eye-catching diagrams and an innovative "hands-on" discovery approach is utilized in the development of concepts. The American influence is quite noticeable with many southern U.S. examples being used. There is some specialized apparatus required, however modification is possible in some instances.

Its main use is as a source of alternate student modules.

9. *Spaceship Earth - Earth Science* - by Jackson/Evans, Thomas Nelson & Sons, 1973.

This book offers a unique and entertaining approach to the study of Earth Science, (see chapter introductions and "Skullduggery" section at chapter end) yet presents an excellent blend of "discover approach" along with concept development. It also offers a balanced approach to the Theory of Evolution and Biblical explanation. Considerable emphasis is placed on space with little emphasis on glaciation. The reading level and the many fine illustrations would make it a very useful primary student text.

10. *Inquiry Into Earth and Space Science* - by Jacobson et al, Van Nostrand, 1969.

This book offers average students a straightforward, comprehensive coverage of concepts plus integrated investigative experiences. There is good coverage of the solar system and weather. The text is offered in hard cover form or individual units may be purchased separately. There is, however, an unusual page-referencing system which may make it difficult to use as a reference. It would seem its best use is as an alternative student text.

11. *Earth Science - The World We Live In* - 4th Edition, by Namowitz and Stone - Van Nostrand Reinhold Ltd., 1972.

A good source of information for the Earth Sciences. The principal areas treated are physical geology, historical geology, oceanography, astronomy, and meteorology and climatology. The text contains many labelled diagrams, black and white photographs and a number of color plates showing minerals and rocks. Each chapter ends with the traditional type of questions and activities; the latter are not integrated within the text. This book is for the above average reader and would be suitable as a reference text.

12. *Our Environment in Space: The Earth Sciences* - Navarra and Strahler - Fitzhenry & Whiteside, 1972.

Content is organized around "Energy Systems". Activities and quizzes appear at end of chapters. The book is colorfully illustrated. Can probably serve best as a teacher and/or library reference.

13. *Pathways in Science: Earth Science* - Oxenhorn, Book Society of Canada, 1968-69-70.

This is a science program with a traditional, content-oriented approach, especially suited to the slow reader. Reading is controlled at the Grade V-VI level. Many photographs and diagrams illustrate the points being made, and promote learning in both the

cognitive and affective domains. Student activities are outlined in detail, and leading questions give directions for the student's "write-up". All terms are fully explained, and points to be learned are restated at the end of each lesson in the form of review questions and in unit glossaries. Some of the explanations are overly simplistic, and may not always satisfy the more mature student. However, the text comprises an important special-purpose resource. The program is available in a hard-cover single edition, and in three separate units bound in hard or soft covers.

14. *Modern Earth Science* - Ramsey et al, - Holt Rinehart & Winston, 1973.

The authors have produced a comprehensive set of materials that presents a view of the Earth and its content in a non-dogmatical way. The program has a high dependence on reading the text and a lot of the activities evolve from an interpretive type of action and tend to be very cognitive in character. The material covers a large number of topics to a considerable depth. The reading and conceptual level is a little high being aimed at a Grade 9 market. For example Kepler's laws are introduced on page 13 and Newton's Law of Gravitation on Page 15 in considerable detail. An excellent resource for the teacher!

15. *Time, Space & Matter* - S.S.S.P. - McGraw-Hill, 1967

Program consists of nine folios which emphasize observation and measurement. Provides a source for laboratory program for the topics it covers but is highly sequential in nature, emphasizes calculation, is directed at the more able student and requires substantial amounts of consumables. Pictorial presentations are excellent for supplementing certain concepts. Some folios might have utility for optional studies.

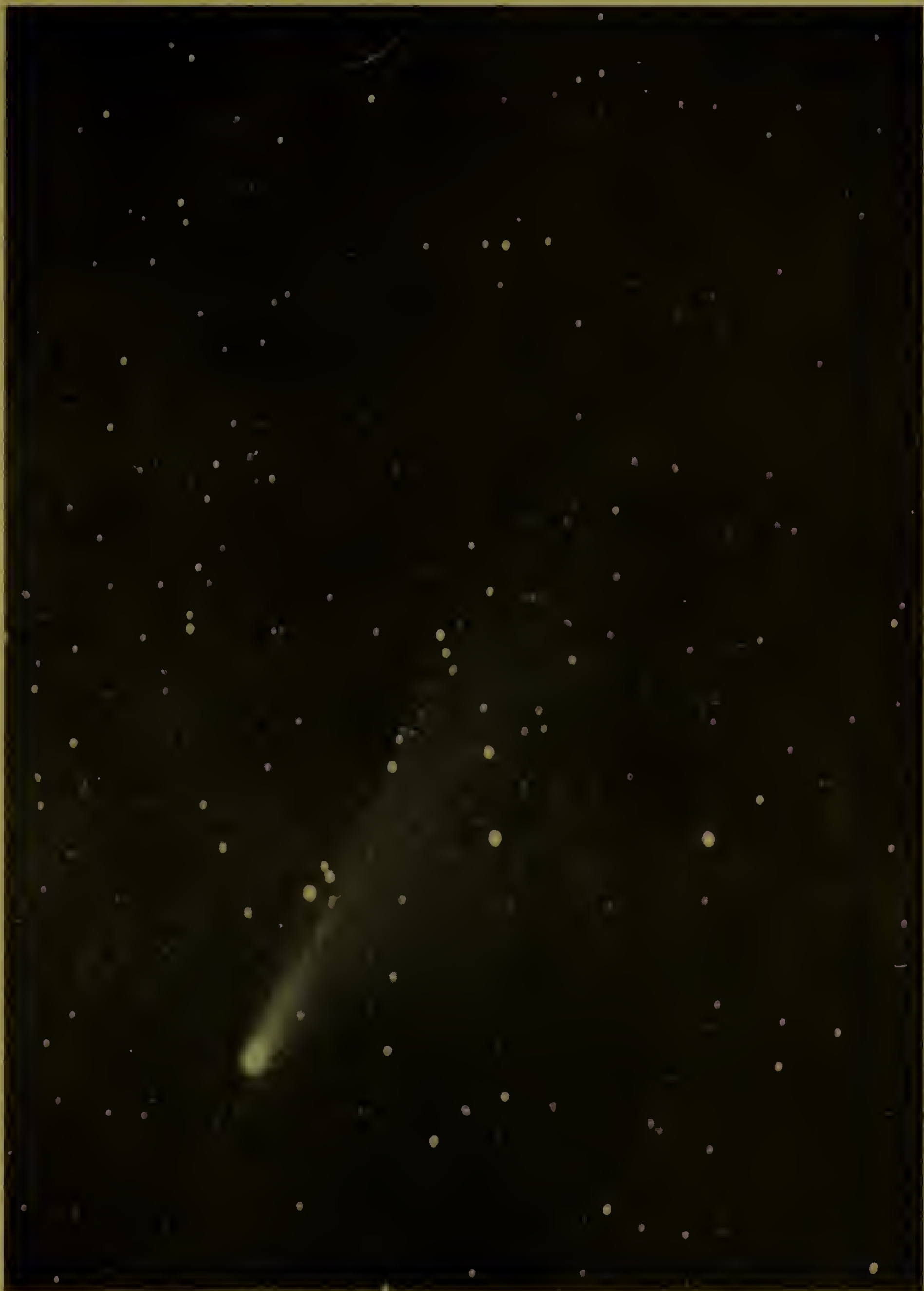
TEACHER REFERENCE BOOKS

In addition to the teacher's editions of the above titles, the following seem especially suited as resources:

TITLE	AUTHOR	PUBLISHER
Exploration of the Universe	George Abell	Holt, Rinehart & Winston, 1969
Geology & Earth Sciences Sourcebook	A.G.I.	Holt, Rinehart & Winston, 1970
Investigations in Earth Science	Beckway & Young	Hubbard Press (Stark Scientific)
A Sourcebook for the Physical Sciences	Joseph & Brandwein	Longman, 1961
The Climate of the Prairie Provinces	Longley, Richmond W.	Environment Canada 1972
The Face of Time	Nelson	Alberta Society of Petroleum Geologists
Newsletter of the U.S. Department of the Interior	United States, Department of the Interior, Washington, D.C., 20240	
Sourcebook for Science Teaching	UNESCO	Information Canada 1962
Sourcebook for Earth Sciences and Astronomy	Utgard, Ladd & Andersen	Collier-Macmillan 1972
Rocks of Alberta - a kit of materials	Research Council of Alberta	
Earth Science: A Lab Approach	Marean, Cote & Coppin	Addison-Wesley, P. 170
University of Illinois Astronomy	Atkin & Wyatt	Harper & Row (Fitzhenry & Whiteside)
Golden Nature Guides *-Fossils* *-Stars* *-Rocks and Minerals* *-Weather*	Zim et al	Golden Press (Fitzhenry & Whiteside)

-Geology
-Landforms
-Ecology

Science and Creation A Handbook for Teachers	Creation-Science Research Center, 2716 Madison Avenue, San Diego, Calif.
List of Resource Materials for Earth Science Teachers in Canadian Schools	Canadian Geoscience Council c/o Queens University



Comet Kohoutek photographed at the University of Calgary Rothney Astrophysical Observatory on January 17, 1974, by Dr. T. A. Clark, and Mr. D. Mackenzie.

PHYSICAL SCIENCE

SPECIFIC OBJECTIVES FOR GRADE 9
PHYSICAL SCIENCE

TEACHING DIMENSION

1. An awareness of the social implications of science can be achieved by having students:

   a. study the peaceful use of atomic energy and consider the implications of the fuel crisis on the development of alternative sources of energy.

   b. study the effects of the different resource technologies in Canada.

2. An appreciation of the nature of science may be gained by having the student:

   a. participate in an organized laboratory program

   b. carry out the study of the historical evolution of a specific scientific principle

   c. follow through and demonstrate an historically important investigation.

3. The development of a positive attitude towards an interest in science may be fostered by having the student:

   a. develop an open-minded approach to controversial issues which are introduced.

   b. develop a responsibility for some part of the laboratory program on a planned, regular basis.

4. Acquisition of basic concepts can be fostered by having students:

   a. participate in structuring learning experiences and evaluating achievement.

   b. experience a wide variety of learning situations and teaching techniques.

5. The development of safe practices should include participation in a continuing lab-safety program.

CONCEPTS TO BE DEVELOPED

Teachers are to use discretion regarding the number of subconcepts undertaken and the depth of coverage in each case.

CONCEPTUAL DIMENSION

A. Matter occupies space and has mass.

Subconcepts

1. Fundamental to the process of science is the establishment of standards for making measurements.
   a. The development of standard units and systems of measurement has taken place slowly.
   b. Good measurement techniques are necessary in order to obtain meaningful data.
   c. All measurements are approximate.
   d. Relationships existing between measurement data are often more clearly defined and understanding clarified, by graphing techniques.

2. Matter can be measured by determining its linear dimensions, its surface area and its volume.
   a. Area is the number of square units of surface.
   b. Volume is the space occupied by matter.
   c. Volume of irregularly shaped solids may be found indirectly by liquid displacement.

3. Matter can be measured in terms of its mass and weight.
   a. Mass is a measure of the quantity of matter in an object.
   b. Weight of an object is a measure of the force of gravity acting on the object.

4. Density (average density) is a measure of the mass per unit volume of matter.
   a. Density is a characteristic property of any given sample of matter and is, therefore, useful for identification purposes.

b. Molecular arrangement influences density.
c. As the volume of a substance changes in response to temperature variation, the density changes.
d. The influence of temperature change on density is generally less for a solid than for a liquid, and less for a liquid than for a gas.

5. Pressure is a measure of force acting on a unit area.
   a. Solids exert pressure on a surface.
   b. Fluid pressure varies directly with depth.
   c. At any point within a fluid, force and pressure are equal in all directions.
   d. Objects placed in fluids are subject to an upward buoyant force.
   e. In moving fluids, pressure decreases as velocity increases.

6. Inertia is a fundamental property of matter.
   a. Matter has a natural tendency to continue in whatever state of motion or rest it is in, at any given instant.

B. The forms and behavior of matter can be explained by the Kinetic Molecular Theory

1. Matter is composed of tiny particles.
   a. A molecule is the smallest particle of matter that has the properties of a larger amount of that substance.
   b. Molecules vary in size.
   c. Spaces exist between the molecules of matter.
   d. Molecular composition determines the chemical properties of matter.
   e. Physical properties of matter are determined by inter-molecular distances and forces.

2. Molecules are in a state of constant motion.
   a. Brownian movement provides indirect evidence of molecular motion.
   b. Motion may be vibrational about a fixed position (solids).
   c. Molecules may be able to slide or move over one another in random directions (liquids).
   d. Molecules may have considerable freedom of movement in random directions (gases).

e. The greater the freedom and rate of movement of molecules of the same kind, the higher their energy content.

3. Heat and temperature are related.
   a. Heat refers to the total energy content of a substance due to molecular motion.
   b. Temperature is a measure of the average kinetic energy content of the molecules of a substance.
   c. Temperature may be measured indirectly by utilizing the response of matter to changes in temperature.
      -An arbitrarily chosen standard is necessary in the construction of most temperature scales.
      -Several temperature scales have been devised:
      - Celsius
      - Fahrenheit
      - Kelvin
   d. Heat is measured indirectly by the effects it produces.
      -Heat is measured by observing temperature changes of a known mass of water at a known initial temperature.
      -Heat is measured in calories.
   e. Different substances absorb or release different amounts of heat, even though they have similar masses and undergo similar temperature changes.
      -The heat capacity of water is greater than that of most other substances.
      -Substances having high heat capacities are good coolants.
   f. When a body at higher temperature is in contact with a body at a lower temperature, heat flows from the first to the second body.
      -Heat is conserved in that the amount of heat lost by one substance is equal to the amount of heat gained by the other.

4. Matter exists in different states.
   a. Matter can exist in solid, liquid or gas form.
      -Each state is characterized by definite general properties.
   b. The addition or removal of heat causes matter to change state.

c. As any given pure substance changes state, its properties change, its composition does not.
d. Temperature remains constant during a change of state.
e. The amount of heat required to change a given quantity of matter from solid to liquid, or from liquid to gas, is called latent heat of fusion and latent heat of vaporization, respectively.

5. A relationship exists between molecular motion and the volume occupied by matter.
   a. With few exceptions the volume of a solid increases as molecular vibrational motion increases.
   b. With the exception of water at temperatures below 40°C, liquids increase in volume as molecular motion increases.
   c. All gases, at constant pressure, expand uniformly as molecular motion increases.

6. Molecular movement is the basis for diffusion.
   a. Diffusion is the penetration of one type of molecule into matter consisting of a second type of molecule.
   b. Diffusion is slow in solids due to limited molecular motion and their closely packed orderly arrangement.
   c. Diffusion takes place more readily in liquids and gases.
   d. Rate of diffusion depends on the temperature of the substances.
   e. Rate of diffusion depends on the size of the molecules involved.
   f. Dissolving is a form of diffusion.
   g. Solutions are formed when molecules of one substance spread out evenly throughout another substance.
      -No boundaries between components of a solution can be observed.

7. Pressure in gases results from molecular motion.
   a. Gas pressure is due to molecular bombardment of a surface.
   b. Pressure depends upon the number of molecules present and their average speed.

c. Compression of gases results in increased molecular motion and thus increased temperature.
d. Expansion of gases results in reduced molecular motion and thus reduction of temperature.

8. Molecular motion results in evaporation.
   a. Evaporation involves a change in state from a liquid to a gas.
   b. Evaporation occurs as faster moving molecules near the surface escape.
   c. Evaporation produces a cooling effect.
   d. Different liquids evaporate at different rates.
   e. Rate of evaporation of a given liquid depends on:
      -Temperature of the liquid
      -Vapor content of the air above
      -Movement of air across the liquid surface
      -Surface area of the liquid that is in contact with the air.

9. Forces of attraction between molecules and characteristics of the molecules of a substance account for many properties of matter.
   a. Cohesion results from the forces of attraction existing between molecules of the same kind.
      -Cohesive forces are greatest in solids, weaker in liquids, and negligible in gases.
      -Tensile strength is a measure of cohesion between adjacent molecules.
      -Ductility, malleability and elasticity depend on cohesive forces.
      -Surface tension of liquids depends on cohesive forces.
   b. Adhesion is the force with which unlike molecules attract each other.
   c. Shape of liquid surfaces depends on cohesion and adhesion.
   d. Capillarity depends on both adhesion and surface tension.

C. The many forms of energy can be transferred from place to place or converted from one form to another, but in each case, the total amount of energy remains constant.

1. Energy is the ability or capacity to do work or cause motion.
   a. Work encompasses factors of force, distance, movement and direction.
      -Work is accomplished only when the applied force causes an object to move in the same direction as the force.
      -Units of measurement have been devised which quantitatively express force, distance and work.
      -The rate at which work is done is defined as power.

2. Energy can be transferred from one place to another.
   a. Work represents a transfer of energy and/or heat.
   b. Machines transfer energy from place to place in order to do work advantageous to man.
      -Considering inclined planes, simple pulleys and pulley systems, and simple levers, machines are devices man uses to multiply force, to change the direction of a force, to gain speed, or to gain distance.
   c. The transfer and conversion of energy underlies conduction, convection, radiation.
   d. The transfer and conversion of energy underlies light, sound and electricity.

3. Energy may be described as either kinetic or potential energy.
   a. Energy is present in the universe in several forms:
      -electrical energy
      -chemical energy
      -mechanical energy
      -heat energy
      -light energy
      -nuclear energy
      -gravitational energy
      -magnetic energy
   b. One form of energy may be changed into another.

4. In all energy changes or transfers, the total amount of energy remains constant (Law of Conservation of Energy).

D. Matter and energy are related and interchangeable.

(Optional unit in terms of both depth and extent of coverage).

1. Theories and/or models have been developed to assist in understanding atoms.
   a. All matter is made up of atoms.
   b. The atomic model has an internal structure consisting of protons and neutrons forming a central core or nucleus, and an outer structure of electrons.
   c. The various kinds of atoms are called elements.
   d. Atoms of the different elements differ from each other primarily in terms of the number of protons contained in their nuclei.
   e. Isotopes are forms of the same element that differ in the number of neutrons contained in their nuclei.

2. A relationship exists between atoms and molecules.
   a. Atoms can exist individually or in combination with other atoms of the same or different elements, and therefore, are the building blocks of molecules.

3. A relationship exists among elements, compounds and mixtures.

4. Matter and energy are interrelated. The total amount of energy and matter in the universe remains constant.
   a. Matter is split apart to release energy in fission reactions.
   b. Matter is combined to release energy in fusion reactions.

E. Energy is responsible for bringing about physical and/or chemical changes in the forms and behavior of matter.

1. There is a difference between physical and chemical changes.
   a. In a physical change, one or more of the properties of a substance are altered but not its composition or identity.
   -A change of state represents one of the most common physical changes.

-Changes in molecular motion and inter-molecular distances and forces of attraction account for physical changes.

b. In a chemical change, atoms are re-arranged resulting in new substances with new properties.
   -Most chemical changes require a great deal more energy than do physical changes.

c. Some changes are reversible, some occur in cycles, some are irreversible.

2. There are several kinds of chemical changes or reactions.

3. Chemical reactions are usually accompanied by energy changes.

4. Rate of chemical reaction may be affected by temperature, concentration, surface area and catalysts.

F. A basic language for understanding chemistry has been developed.

(Optional unit in terms of both depth and extent of coverage).

1. The Periodic Table arranges elements in a logical order.
   a. Development of the Periodic Table has taken place over many years.
   b. Names of elements have varying origins.

2. A simple appreciation of how elements combine is necessary for the understanding of compound formation.
   a. Limited study of the nomenclature of common compounds may facilitate such understanding.

PRINT RESOURCES - GRADE 9 - PHYSICAL SCIENCE

RECOMMENDED TEXTS

*Marean & Ledbetter, *Physical Science: A Laboratory Approach*, Addison-Wesley, 1968.

*Thurber & Kilburn, *Exploring Physical Science*, MacMillan of Canada, 1969.

SECONDARY REFERENCES

TITLE	AUTHOR	PUBLISHER
Physical Science Investigations	Bickel, Eigenfeld & Hogg	Houghton Mifflin Co., 1973 (Thomas Nelson & Sons (Canada) Ltd.)
Energy: Its Forms and Changes	Brandwein, Stollberg, & Burnett	Longman Canada Limited, 1968
Physical Science: A Problem Solving Approach	Carter, Bajema, Heck, & Lucero	Ginn and Company, 1971
The Physical Sciences	Fisk & Blecha	Laidlaw Brothers, 1971 (Doubleday Publishers)
Interaction of Matter & Energy	I.S.C.P.	Gage Educational Publishing Limited, 1969
Inquiry Into Physical Science	Jacobson, Kleinman, Hiack, Carr & Sugar-baker	Van Nostrand Reinhold Ltd.
Our Physical Environ-ment: The Physical Sciences	Navarro & Garone	Harper & Row (Fitzhenry & Whiteside), 1973
Pathways in Science, Chemistry 1,2,3, Physics 1,2,3	Oxenhorn	Book Society of Canada, 1968
Foundations of Physical Science	Ramsey, Phillips & Watenpaugh	Holt, Rinehart and Winston, 1967
Energy, Matter & Change	R. D. Townsend	Gage, 1973

*(Under review)

TITLE	AUTHOR	PUBLISHER
Challenges to Science: Physical Science	Williams, Doerhoff & Bolen	McGraw-Hill, 1973

TEACHER REFERENCES

In addition to the teacher's editions of the above titles, the following seem especially suited as resources:

TITLE	AUTHOR	PUBLISHER
Toward More Effective Science Instruction in Secondary Education	H. O. Andersen & P. G. Koutnik	Collier-Macmillan 1972
A Source Book for the Physical Sciences	Joseph & Brandwein	Longman Canada, 1961
Introductory Physical Science, 2nd Ed.	PSSC	Prentice-Hall, 1972
Source Book for Science Teaching	UNESCO	Information Canada 1962
Focus on Physical Science	Heimler & Price	Charles E. Merrill, 1969
Working with Energy	Hughes, Laventure	Thomas Nelson & Sons, 1970
Working with Matter	Ross & Craig	Thomas Nelson & Sons, 1970

SUGGESTIONS FOR IMPLEMENTING THE SCIENCE PROGRAM

A. AN APPROACH TO THE TEACHING OF JUNIOR HIGH SCHOOL SCIENCE.

1. *Nature of Science*

Today's science programs emphasize inductive modes of inquiry. In the past, much science teaching in the Junior High School has treated science as dogma. To a large degree, the difference stems from one's definition and view of science. In oversimplified terms, when science is regarded as an accumulation of facts, it is defensible to design curricula with the goal of creating the most efficient scheme for teaching these facts. On the other hand, when science is regarded as an active, human process for acquiring knowledge, curricula must be designed to bring the learner into a direct encounter with this process. The substance of inductive inquiry is data; data and concepts are essential ingredients of inquiry. However, they are not the totality of science; processes of inquiry must be included and balanced against content.

In today's Junior High Science programs inquiry involves human activity in search of meaning. It involves both the student and the teacher in an active process. Recitation followed by student feedback would seem to be antithetical to the process of inquiry. Science is a body of knowledge and a process of inquiry.

Students should be given opportunities to recognize, understand, and evaluate the social and environmental consequences of scientific discoveries. The humanistic view of science should receive substantial emphasis. In order for students to understand the significance of science in the progress of civilization, they should be challenged to bring scientific considerations into social issues.

2. *Process Skills*

Strong recognition must be given to process. However, process skills should not be developed simply for their own sake. Rather, process skills, including observing, interpreting, and hypothesizing should be developed as an integral part of programs and used as they are required by the student to gain and process data and information to develop concepts.

3. *Concept Formation*

It is important for the teacher to remember that a concept is a gradually-developing and continuous verbal and mental image, which is unique to each student. Concepts are not taught directly by the teacher, but are primarily the result of mental and physical activity on the part of the learner. Experiences with real things should be presented within a conceptual framework.

A highly diversified program emphasizing direct physical experiences reinforced by the use of print and non-print materials and discussion is essential to the development of most concepts. Only then will early learning form a base to the assimilation of experiences that come later--experiences that may involve either direct observation (using all the senses) or verbal and pictorial reports of observations made by others.

B. USE OF TEXTBOOKS

All too often a textbook has been accepted in many classrooms as the program of studies. Experience has shown that the use of a single text has resulted in problems when teachers attempt to meet the range of individual abilities. One must consider both the strengths and limitations of a textbook and exercise discretion in its use. The use of a variety of texts helps to provide alternate methods and approaches to accommodate ranges of performance and interest. No text, manual, or single aid will provide a creative and appealing approach to instruction. Children differ and communities are varied, so that the creative ability and background of children demand variation in instructional patterns.

C. STUDENT EVALUATION

The nature of the Junior High Science course, i.e. an activity-centered science course geared to providing *successful* student experiences calls for different kinds of teaching and evaluating. Too often we assume that students have skills and are able to use scientific processes. These skills and processes must be taught, practiced, and evaluated. This evaluation should be continuous with maximum student participation.

Evaluation should also be concerned with the attainment of conceptual knowledge but there should also be a large component concerned with the attainment of the affective goals. That is to say we must attempt to measure not only the pupil's growth in the knowledge dimension but also in the attitudinal dimension.

D. SAFETY AND MAINTENANCE OF THE SCIENCE LABORATORY

1. Teachers should be aware of potential hazards incumbent in any experiment or demonstration which is to be incorporated into the science program.

2. Students should be made aware of hazards in doing any experiment and should be made to understand and follow the directions.

3. Chemicals should be stored in a safe, secure, and orderly manner.

4. All laboratory activities should be supervised.

5. Students should be taught how to use and care for laboratory equipment.

6. All apparatus and equipment should be in good repair.

7. Safety equipment (fire extinguishers, asbestos blankets, eye washers, first aid kits, etc.) should be readily accessible. Students should be instructed in the proper use of this equipment.

SUGGESTIONS REGARDING A FIELD STUDIES PROGRAM

FIELD TRIPPING OR OUTDOOR EDUCATION

STATEMENT

Field tripping or outdoor education as a valuable contributing component to any total educational program in our Alberta schools is now recognized and accepted. Nevertheless schools or classes contemplating such activities must bear in mind certain responsibilities. This statement is presented here to alert teachers, principals, administrators, and others so that all necessary steps may be taken to ensure success.

A good deal of literature, local and otherwise, now exists on this topic and those undertaking field tripping for the first time would be well advised to avail themselves of this information where possible. Adequate pre-planning is the key to a successful field trip whether it be

of short or long duration; whether it be taking students a few hundred yards or several hundred miles.

A field trip must be based on clearly defined objectives. Since field tripping requires an expenditure of a great deal of time and often money, the results to students should at all times justify the efforts necessary.

In setting objectives and in pre-planning the undertaking many important considerations have to be taken into account. Some of these relate to the age of the students, parents' consent, compliance with board policies, and adequate and responsible adult supervision. There are many others.

To fully cover the topic of field tripping or outdoor education is not the intent of this publication. The intent is to suggest that field tripping cannot be undertaken lightly and that careful planning must precede any such activity.

The following check list is included as a sample guide in suggesting the kinds of items which should receive attention.

*CHECK LIST

(Not all-inclusive and only suggestive)

( ) 1. The objectives of the field trip have been clearly identified.

( ) 2. The field trip site has been visited and studied.

( ) 3. Field trip site entry has been cleared and booked.

( ) 4. Students who will participate have been identified.

( ) 5. An outline of student activities has been prepared.

( ) 6. Permission from the proper school authorities has been obtained. (School Board included).

( ) 7. Parental consent has been obtained in writing.

( ) 8. All financial commitments have been looked after.

( ) 9. All teachers whose classes may be affected have been properly consulted.

*Adapted from *A Guide to Field Tripping*, Calgary Board of Education.

( ) 10. Any required student skills have been taught.

( ) 11. Proper and adequate transportation has been arranged.

( ) 12. A full schedule of times and events has been prepared including departure and arrival time.

( ) 13. Adequate and responsible adult supervising personnel have been assured.

( ) 14. First aid requirements have been met.

( ) 15. Proper clothing requirements have been established.

( ) 16. Guidelines for behavior have been established for all.

( ) 17. Proper and adequate food supply has been assured.

( ) 18. Duties and responsibilities of all supervisory personnel has been outlined.

( ) 19. Supplies and equipment for all have been identified and arranged for.

( ) 20. Safety precautions have been outlined.

FOLLOWING-UP A FIELD TRIP

It is generally accepted that follow-up activities are of equal importance to the in-the-field experience. Some follow-up activities might include reporting by various committees on the data collected, organization and review of ideas and materials gathered, bulletin board displays, demonstrations, worksheets, discussions and testing and identifying specimen materials obtained. Each student should have some responsibility in interpreting what he saw and explaining what it means.

EVALUATION

The teacher should attempt to determine the degree to which his other purposes for taking the field study were met. Evaluation might include completed questionnaires, student prepared booklets, and evidence that might be collected to support the general objectives of Junior High Science. Problems that arose should be noted for revision of plans for future trips. Some attempt should also be made to determine the usefulness of the resource site for future field studies.